Fall/Winter 2000 Issue Number 35

Radionavigation Bulletin

Nationwide DGPS Status Report

How fast time flies! Another year has gone by since my last report, and it's been very exciting! The relatively small Coast Guard Nationwide DGPS (NDGPS) implementation team has focused on several key issues: equipment transfers, equipment re-engineering, and site construction. As of 1 November, four former GWEN sites have been converted to transmit NDGPS corrections, bringing the total of operating NDGPS sites to twelve. The new sites are located near Macon, GA, Flagstaff, AZ, Billings, MT, and Hudson Falls, NY. The Hartsville site has upgraded to a permanent 299' antenna, while Appleton continues operation in its test configuration.

In addition to the four conversions, three sites are in the construction phase, having completed real estate transfers and environmental review. These sites are Spokane, WA, Polson, MT, and New Bern, NC. The New Bern site will replace the existing USCG site at nearby Fort Macon, NC, providing better interior coverage while lessening the exposure to service-threatening hurricanes.

The three remaining sites we hope to complete in the next few months are near Kirtland, NM, Summerfield, TX, and Annapolis, MD. The Coast Guard and the Federal Highway Administration are working diligently to complete the associated property and environmental paperwork. I expect these will be completed to allow construction in the early months of 2001.

In addition to all of this construction, we've pursued several new site investigations in the following regions: southeastern Ohio, central Minnesota, south central Idaho, eastern Utah, along the Alaska rail corridor between Anchorage and Fairbanks, and central North Carolina - all in partnerships with local, state and Federal agencies. These sites are in various stages of property, permit, and environmental approval. Contractors are preparing the installation design plans for the site near Myton, UT, in preparation for construction next year.

So what is planned for next year? Obviously, we can't build without funding, and as I write this in mid–October, the Conference Report from Congress contains $6M for NDGPS operations, maintenance, and construction in Fiscal Year 2001. Of that, at least half will fund personnel, maintenance of operating sites, caretaker activities at unconverted GWEN facilities, electricity, generator fuel, etc. While these costs are not small, approximately $2.5M is available to fund the various construction efforts. Once the DOT Policy and Implementation Team, which oversees project implementation, decides which sites should be constructed/converted with these funds, I will post that list on the NAVCEN's website.

— LCDR Gary Schenk, NDGPS Project Implementation Officer

Inside this bulletin:

From the Commanding Officer...

I would like to take this opportunity to highlight our partnerships. Within the Radionavigation program, we see these partnerships as one of our critical success factors in a period where we are experiencing significant changes to the Radionavigation infrastructure that the Coast Guard has under its responsibility. These partnerships have been devised and developed in an effort to do the right thing right, and are a testament to the superior professionalism and competence of the individuals that work with us on a day in and day out basis.

To begin with, we have critical alliances within our own organization. Now you may claim that this is inescapable since we are all Coast Guard employees, and you may be right to a certain extent. But the unselfish willingness to roll up sleeves across organizational boundaries and pitch in has been one of the most extraordinary experiences of my career. Those that I have observed close to home has involved the Loran Support Unit, C2CEN, staff personnel from G-OPN, G-SCE, and the MLCs. For those who may not be aware, we are breaking new ground on many fronts… Prototype Loran Automation, Loran Modernization, DGPS (maritime) and DGPS (nationwide) site commissioning and, Control Station upgrade are just a few of the higher visibility initiatives that we are working together to make happen. To understand where I'm coming from, take a peek into the conference room where the PALs Team is hard at work cobbling together THE plan, or where the NOG/DOG team is reviewing Control station upgrade developments. Note the assortment of individuals based on where they are from and the level of involvement of each participant. It truly is a team effort and it's impressive to say the least.

There are many partners who we've built relationships with from outside of Coast Guard and are players in helping us to accomplish our goals. For instance, the Federal Aviation Association has been side by side with us to hammer out the modernization project plan and meet the objectives of both of our organizations while optimizing the scarce resources we have to work with. In another forum, the Army Corps of Engineers has taken steps to resolve long standing support issues in striving to meet DGPS availability goals. DOT staff personnel and Federal Railroads Agency representatives sit down with us routinely to work out NDGPS implementation.

The systems that we operate today and in the years to come will greatly benefit from the hard work of these cross-organizational teams.

To all our partners…I salute you!

—— CAPT Tom Rice, NAVCEN

There are many partners who we've built relationships with from outside of Coast Guard and are players in helping us to accomplish our goals.

U.S. Coast Guard
Navigation Center
7323 Telegraph Rd.
Alexandria, VA 22315-3998

Issue Number 35
Fall/Winter 2000

Contributors: Articles are welcome from all parties. Articles for publication should be sent to: Commanding Officer, USCG NAVCEN, 7323 Telegraph Road, Alexandria, VA 22315-3998. Articles may be submitted typewritten in 10 or 12 characters per inch, on an IBM-PC compatible 3.5 inch floppy disk (returned on request), or electronically mailed to ***rnb@navcen.uscg.mil***. The Radionavigation Bulletin staff reserves the right to edit all material submitted. Copyrighted material will not be accepted without the author's and/or publisher's written release/permission.

Readers: We welcome your comments. Critiques, complaints and distribution concerns should be directed to the above address.

Contents

A New Chapter In RadioNavigation History

Today we stand on the edge of a new horizon. As we look back at the close of a great chapter in RadioNavigation (Rnav) history, we recognize the contributions of some of the earlier systems. During their time, the Omega Navigation System and others, including Radiobeacons, represented cutting edge technology. They provided years of faithful service to mariners all around the world. As the predecessors to present-day RadioNavigation systems, they deserve the fullest recognition and highest level of respect from the Rnav community.

This is indeed a most exciting time. Even as we say farewell to yesterday's generation of RadioNavigation systems, it is extremely difficult to contain the excitement of the possibilities for the next generation. The Loran community is showing the world that you truly can teach an old dog new tricks. Development of the Prototype Automated Loran Station (PALS), the Loran Data Channel and even research in diplexing DGPS with Loran signals are all rejuvenating innovations, which open up an endless number of new possibilities for Loran. In early May of this year, many people were reconsidering the need for DGPS with the termination of Selective Availability. Since then, the initial doubts have melted away with a renewed confidence in its purpose. Clearly, DGPS remains the primary source of the accuracy and integrity required by the maritime community and safety of life applications.

It is at this point we begin a new chapter in RadioNavigation. Just as in 1994 when DGPS was first introduced to the world as cutting edge technology, the Coast Guard again is leading the way in the Rnav community. The Nationwide expansion of DGPS in itself is an innovative application of DGPS. NDGPS is a tremendous enabler that opens the door to a whole new realm of terrestrial applications. From the well-known uses such as enabling Positive Train Control for the Federal Railroad Administration and Precision Farming, to regional uses such as Automated Snowplows and High School science projects, the use of DGPS is spreading faster than ever imagined.

In addition to NDGPS, NAVCEN is also working on new initatives to take advantage of the termination of Selective Availability. The “Link Enhancement Analysis: feasibility study is investigating the possibility of diplexing Real Time Kinematics (RTK) corrections with the DGPS signal. This additional correction would reduce position error even further, allowing for the first time centimeter level accuracy across an entire positioning system!!

The Coast Guard has their work cut out for them to keep up with the breakneck speed of the emerging technologies and Nationwide expansion. This is truly a cooperative effort not only within the Coast Guard, but also with the U.S. Air Force, the Federal Highway Administration, the Federal Railroad Administration and the U.S. Army Corps of Engineers to name a few. Within the Coast Guard, NAVCEN is also working very closely with Headquarters and the many support commands to provide an adequate infrastructure to meet the present and future needs of the system. Again, we are amidst a very exciting period of RadioNavigation. What we do today builds the foundation of the DGPS program for the next 20, 30 maybe even 50 years—whatever the lifecycle of DGPS might be. And who knows how long that will be, for the future holds endless possibilities!

—– LT Daniel Pickles, NAVCEN

Sea Service Credit For Loran-C ET Duty

Director of Personnel Management has reviewed a request, to allow ET's assigned to LORAN-C duties to receive a waiver of sea time credit for advancement purposes. After careful consideration, and recognizing the gravity of the safety concerns caused by a declining population of experienced technicians to properly support this mission, the proposal was approved. The approval is subject to the following conditions:

- Waivers of the sea service requirement for advancement will be considered on a case by case basis for those individuals actually serving on a second LORAN-C tour of duty.
- Waivers will only be granted for advancement up to pay grade E-6.

—– Thomas F. Fisher, G-WPM

System Operational Verification Testing (SOVT) For An NDGPS Broadcast Station

The System Operational Verification Testing (SOVT) for a Ground Wave Emergency Network (GWEN) site conversion to Nationwide Differential Global Positioning System (NDGPS) Broadcast Station is a procedural check-off list developed by ENSCO Inc. Applied Technology and Engineering Division under a contract with the Coast Guard**.** Command and Control Engineering Center (C2CEN) is now the lead SOVT unit for the CG. The SOVT provides a controlled method of conducting system testing. The purpose of this testing procedure is to verify the physical installation and operational integrity of a DGPS site. It measures and documents the quality of the site construction and initial operation. Information gathered during the testing serves as a baseline record of the physical installation and initial operational parameters. Comparison of this baseline measurement to future measurements will assist in maintaining the quality of the site's operation over its expected 15-year lifecycle.

The SOVT provides guidance's for checking the entire DGPS site. In some procedures that require fairly complicated test setup, the SOVT check-off sheet provides helping instructions and diagrams. Even driving directions to the site and to the GIS monument that was used to survey the site location is documented by the SOVT. The SOVT is done at the end of a GWEN to DGPS conversion, at the end of a two-week construction process. Two people normally complete a SOVT in three to four days.

The configuration audit of the SOVT is an inventory performed to document installed equipment by model and serial number. It also lists spare equipment or modules provided to the site. A list of supporting documentation such as technical manuals and manufacturer's operating guides are checked to ensure they are held on site.

The physical installation inspection ensures equipment is installed properly per the installation specifications and drawings. Proper installation techniques are also checked. This includes point-to-point wiring inspections, Time-Domain Reflectometer (TDR) testing of RF cables, inspection of all grounds and ground connectors including a resistance check for each ground radial of the antenna, and a record of the equipment settings. The site's roads are inspected for proper rainwater drainage. Numerous digital photographs of the site are taken for future reference.

Operational verification includes baseline measurements to set the broadcast tolerances of the beacon. This includes a baseline site spectrum analysis in both daylight and nighttime hours (to check for presence of interfering signals to GPS and DGPS), equipment turn on, initialization procedures and final broadcast signal verification. Field intensity is measured in both the near field and far field for broadcast signal strength verification and compared to COAST (a coverage prediction-modeling tool). Finally, remote tests are performed with C2CEN to check remote control station operations.

Personnel safety is very important. The SOVT checks safety equipment, tower climbing guards and that an emergency contact phone list is posted. Emitted radiation from the beacon transmitter is recorded to compare to the guidelines contained in **COMDINSTM. 25: USCG Electronics Manual and ANSI/IEEE C95.1-1992 guidelines.** The Tower Light Monitor is checked. The auto dialer is programmed to call the proper CG units for the status of various site conditions.

From the Drawings and technical publications to the gravel road, every item of the new site is thoroughly checked to ensure the unmanned site will perform within specs. Once completed, copies of the SOVT are mailed to the support and operating activities.

—– ENS Dean Jordan, NAVCEN

ENS Dean Jordan
Public Affairs Officer
CG Navigation Center

E-Mail:
djordan@navcen.uscg.mil

Phone number:
(703) 313-5939

CGSIC 36th Meeting

The Civil GPS Service Interface Committee (CGSIC) held its 36th meeting in Salt Lake City, Utah on 17-19 September 2000. Over 200 attendees participated in the meeting that reviewed the latest in policy changes and applications developments. The following paragraphs summarize the main policy topics covered in the meeting.

Civil GPS Modernization

The first step in modernization was President Clinton's order to discontinue Selective Availability on 2 May 2000. Accuracy immediately improved from 100 meters to better than 20 meters.

The additional civil signals that will be added to L2 and L5 will provide improved accuracy, availability, and redundancy to the system. The civil signal at L2 will be available beginning in 2003. The third civil signal, which will be in a protected band for aviation and other safety of life uses, will be available beginning in 2005.

The draft L5 Signal Specification is complete and was approved by RTCA SC 159 Plenary on 16 June. The U.S. Government concurrence process is underway, with publication expected in December 2000. L5 will give improved ranging precision and accuracy and robustness in interference and low SNR conditions. In addition, the format will be flexible to allow for future growth and improvements.

The GPS III architectural effort is underway. The Department of Transportation is now examining how the civil sector can best participate in the process.

The GPS SPS Signal Specification is being updated to reflect the improved constellation performance and the discontinuance of SA. The statistics will reflect improvements in the operation of the system. The current specification statistics are pre-Full Operational Capability and do not represent the improvement efforts of the last eight years.

Civil GPS Congressional Outreach

There is a need for strong Congressional support for Civil Agencies involved in GPS and Augmentations to GPS. As a result, DOT developed a *"National Civilian GPS Services"* brochure that was distributed to Congress, and a GPS Industry Trade Fair was held on Capitol Hill on 20 June 2000. FAA, FRA, and FHWA Administrators gave GPS testimony before Congress.

International Outreach

The U.S. is continuing cooperative efforts to ensure interoperability with GPS and other Space-based navigation systems. A Memorandum of Agreement (MOA) is being developed with the European Union (EU) regarding GPS and Galileo. Currently, it is undergoing clearance within the U.S. Government and will be made available to the EU in the near future.

The principles for cooperation are outlined in the MOA. These include:

(1) no direct user fees for civil and public safety services
(2) ensure an open market
(3) provide an open signal structure for all civil services
(4) protect the spectrum from disruption and interference
(5) use GPS time, geodesy, and signal structure standards
(6) work towards a seamless, global interoperability, and
(7) recognize national and international security issues and protect against misuse

DOT/DoD MOA on Implementing Unique Civil Requirements

On 12 August 2000, the MOA between DOT and DoD on the civil uses of GPS became effective. This MOA provides a description of the agreed to civil signals, and gives guidelines for validating and implementing new signals. The MOA provides a mechanism for prioritizing elements should appropriations be insufficient. The Interagency GPS Executive Board (IGEB) members will participate in development of new unique civil requirements.

GPS Vulnerability Assessment

GPS is an important utility that has become integrated into transportation infrastructure. Since the GPS signal is weak and at risk of interference, PDD –63 directed DOT to conduct an independent vulnerability study. The Volpe National Transportation System Center is conducting a study to recommend appropriate mitigation measures, which will include new technologies (i.e., INS, new antenna arrays). The study will be completed by the end of 2000. The results will be used in DOT radionavigation policy decision making. As a result of the study, the DOT might need to examine current policies on backup systems and technologies.

Civil GPS Service Interface Committee Salt Lake City, Utah—Sep. 17-19, 2000

LT Langevin, TCC Wade, QM2 Ghigileri & PO Bosarge

Ian Mallet, Hank Skalski, Rodney Bracefield & Graeme Crosby

Spectrum

World Radio Conference (WRC) 2000 was held in June 2000 in Istanbul, Turkey. The efforts to protect navigation, especially GPS, spectrum against encroachment from other systems and to obtain allocation for 3rd Civil GPS Signal at 1176MHz were highly successful. The fight is not over and the GPS community needs to start preparations for WRC 2003. The effort to maintain international cooperation needs to continue.

Ultra Wide Band (UWB) is new technology where a low power signal is spread over wide area of spectrum. UWB Technology may pose a threat to the use of GPS and other systems used for safety of navigation. Testing is needed to determine its effects on GPS. National Telecommunications and Information Administration (NTIA)/Stanford is conducting testing with an October deadline for test results to be submitted to the Federal Communication Commission.

2001 Federal Radionavigation Plan

User conferences were held in Washington and San Diego to collect user input for the 2001 Federal Radionavigation Plan (FRP). The draft should be complete in December 2000 with a formal U.S. Government clearance process in January 2001. The target publication date is July/August 2001.

One of the proposed changes for the 2001 FRP is to organize it into a two-document Structure. The FRP would retain policies, operating plans, and R&D Sections of the previous document. The Federal Radionavigation Systems (FRS) would contain static information (e.g. Systems Descriptions, requirements, & roles and responsibilities).

—– Rebecca Casswell, NAVCEN

Electronic Charting Standards and the International Hydrographic Office

On September 18-22, 2000 I represented the Navigation Center (NAVCEN) in a series of International Hydrographic Office (IHO) sponsored Electronic Charting Standards and Industry Outreach working groups at the International Hydrographic Bureau (IHB) in Monaco. Because the electronic charting display is increasingly the media on which radionavigation information is displayed, it is important for the Coast Guard and NAVCEN to remain engaged in the development of Electronic Navigational Chart (ENC) standards. The meetings covered three distinct but related areas:

a. ***Data transfer standards***

   Electronic charts are essentially data files, which must be translated by software for display on hardware. The data format requires standardization.

b. ***Colors and symbols***

   This group determines what the display looks like when the database is translated. This includes color palettes and a presentation library of chart symbology. This work crosses over into other community's standards, particularly what are called Marine Information Objects (MIO). The essential difference between hydrographic objects and MIOs is time. An MIO is typically time dependent, and may move in relation to the chart display, where a hydrographic object (such as a buoy) will remain static. These symbols are being harmonized to ensure it is easy to interpret the display.

c. ***Interface between the international hydrographic community and the "Outside World"***

   Issues raised in the above two working groups highlighted the need to establish better vehicles for communication between the Hydrographic community and the rest of the world, particularly mariners, manufacturers, test houses, and regulatory authorities like the U.S.Coast Guard.

—— LT Daniel Mades, NAVCEN

RF Analysis of the Annapolis NDGPS Site

The Annapolis, MD USAF Ground Wave Emergency Network (GWEN) site is scheduled to be converted for use as a Nationwide Differential Global Positioning System (NDGPS) broadcast site during the first quarter of FY01. Located 980 feet to the southwest of this GWEN Tower is an 855 foot tall television tower.

During the initial conversion study, concerns were raised about the affects this TV tower would have on the NDGPS signal. Using computer modeling software, the US Coast Guard's Command and Control Engineering Center's (C2CEN) Radio Frequency (RF) Engineers reviewed the Annapolis site for signal strength and radiation patterns at the DGPS frequencies. The models showed that, although the TV tower has an affect on the radiation pattern, it should not significantly degrade the coverage area of the Annapolis site.

The MININEC® for Broadcast Engineers v1.0 computer program was used to run C2CEN's analysis. The MININEC® program is used to design and analyze wire antennas. Within the program, a model of an antenna is created using a series of straight, segmented wires of varying diameters. Once the antenna is "built", the program can calculate numerous Radio Frequency (RF) and power parameters, including effective radiated power, antenna impedance and radiation patterns for a given current or voltage source.

The Annapolis GWEN tower was modeled by 10 wire segments with a 0.695 foot radius for a total height of 299 feet. There are 12 Top Loading Elements (TLEs) again comprised of 10 wire segments with a radius of 0.0160833 feet for a total length of 202' 8" at an angle of 45 degrees from the top of the antenna. The GWEN tower's ground plane consisted of 100 radials at a total length of 303.1 feet with the same radius and number of segments as the TLEs. The TV tower was modeled in three sections. The first section was grounded and was comprised of 25 wire segments each with a radius of 2.821 feet for a total height of 777 feet. The next section was a 3 foot long insulator. The third section was 75 feet tall, modeled with 10 wire segments, each with a 1 foot radius for a total TV antenna height of 855 feet.

The wavelength of the DGPS frequencies is approximately 3,300 feet, the TV tower is 855 feet tall (approximately ¼ wavelength) and is 980 feet away from the GWEN tower (approximately 1/3 wavelength). This configuration is a very basic form of a Yagi-Udi Array, which is a directional antenna with the GWEN antenna acting as the driven component and the TV antenna acting as a reflector.

The radiation pattern of a normal GWEN tower is omni-directional, i.e., equal power in each direction for all frequencies. At Annapolis, the radiation pattern is more directional, with the maximum signal strength to the east of the site (away from the TV Tower). The radiation pattern changes with frequency (see figures below) while the direction of the minimum signal strength changes, but is basically to the west of the GWEN tower.

The attached figures show the radiation patterns at 500 km for a standard GWEN configuration (same pattern for all frequencies only the power level changes) and the predicted radiation patterns for three frequencies at Annapolis (285 kHz, 305 kHz and 325 kHz). The assigned frequency of Annapolis is 301 kHz, so the radiation pattern will be very similar to the 305 kHz plot (figure 3).

The antenna model is radiated at 500 Watts Effective Radiated Power and assumes a constant "average" ground conductivity in each direction. To obtain the signal strengths at 500 km, the 1 km signal strength from the "average" ground calculation was entered into the FCC groundwave calculation formula, this gave more realistic values at 500 km. Even with these values, the Mini-NEC program has a very primitive ground model so these signal strengths should only be used as relative comparisons not absolute values.

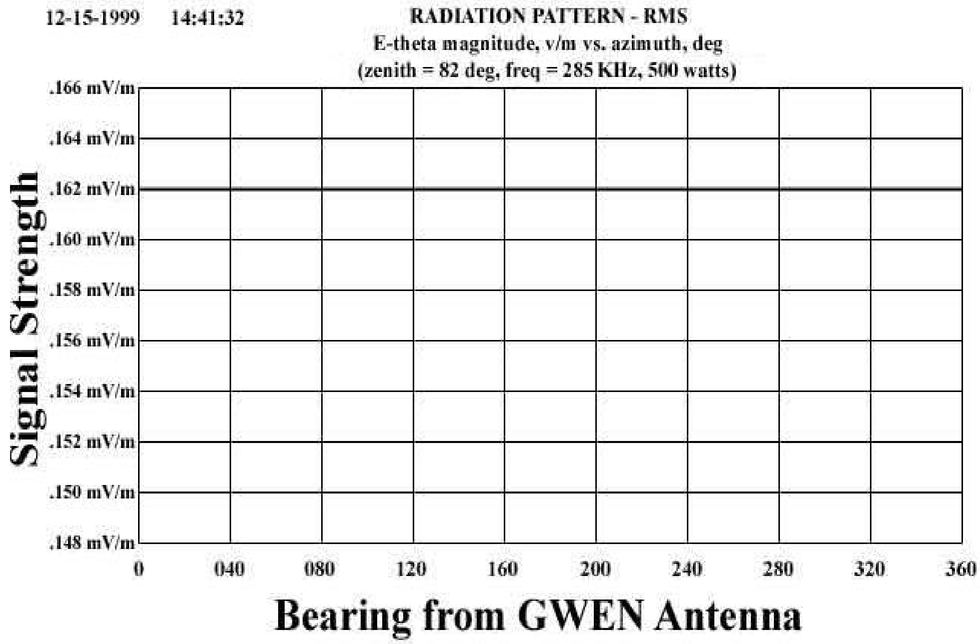
As the attached figures demonstrate, the radiation pattern of Annapolis is frequency dependent, with 285 kHz showing the most distinct radiation lobes. It should also be noted that the bearings are not "true" but based upon the TV Antenna being 270 degrees relative to the GWEN antenna. To get the true directions of the radiation pattern approximately 10 degrees should be subtracted from those displayed.

The following chart compares the signal strength of Figure 1 (generic GWEN Radiation pattern for all frequencies) to the signal strengths of Figures 2-4 (Annapolis configuration at different frequencies) at a distance of 500 km from the GWEN antenna.

	Modeled Annapolis GWEN with TV Tower.		Modeled GWEN without TV Tower.	Differences Between two models.	
Frequency	Max Signal Strength	Min. Signal Strength	Omni-Directional Signal Strength	Max	Min.
285 kHz	237 μV/m @ 080° T	93.6 μV/m @ 180° & 340° T	162 μV/m	+ 3 dB	- 5 dB
305 kHz	227 μV/m @ 080° T	64.3 μV/m @ 215° & 305° T	152 μV/m	+ 4 dB	- 7 dB
325 kHz	182 μV/m @ 080° T	78.2 μV/m @ 220° & 300° T	143 μV/m	+ 2 dB	- 5 dB

The Television tower will have an affect on Annapolis's NDGPS Signal however, it will not significantly degrade performance. The tower's main effect is to increase the signal strength to the east of the tower approximately 3 db while attenuating the signal approximately 5 db in other directions depending upon the frequency. Once the site is operational, a field-strength analysis will be conducted on the actual signal to validate the analysis done and, hopefully, improve the ability of C2CEN to predict the radiation patterns of future installations.

—– LT David Godfrey & CWO3 Eamonn Manley, C2CEN



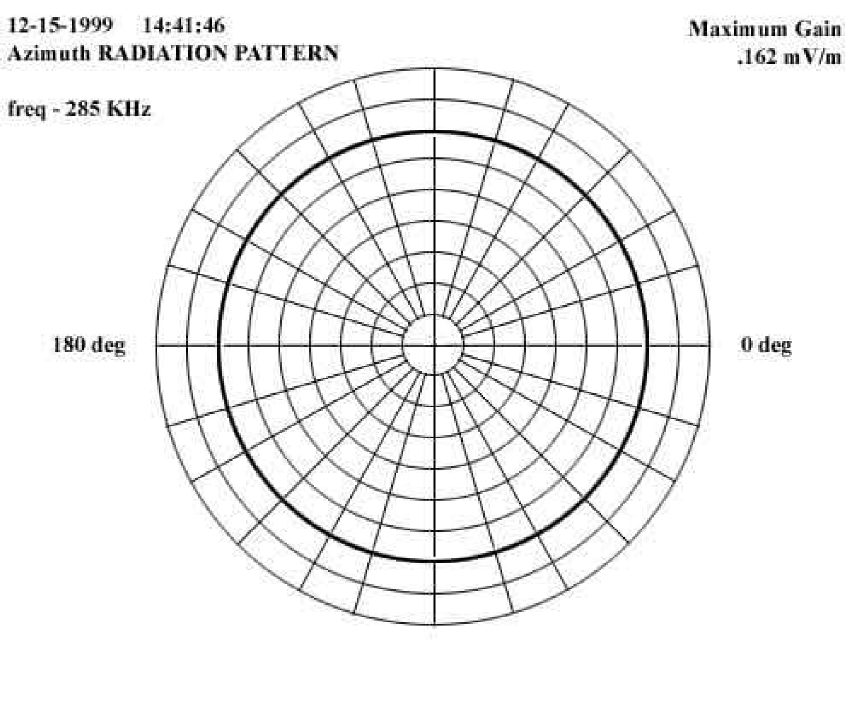
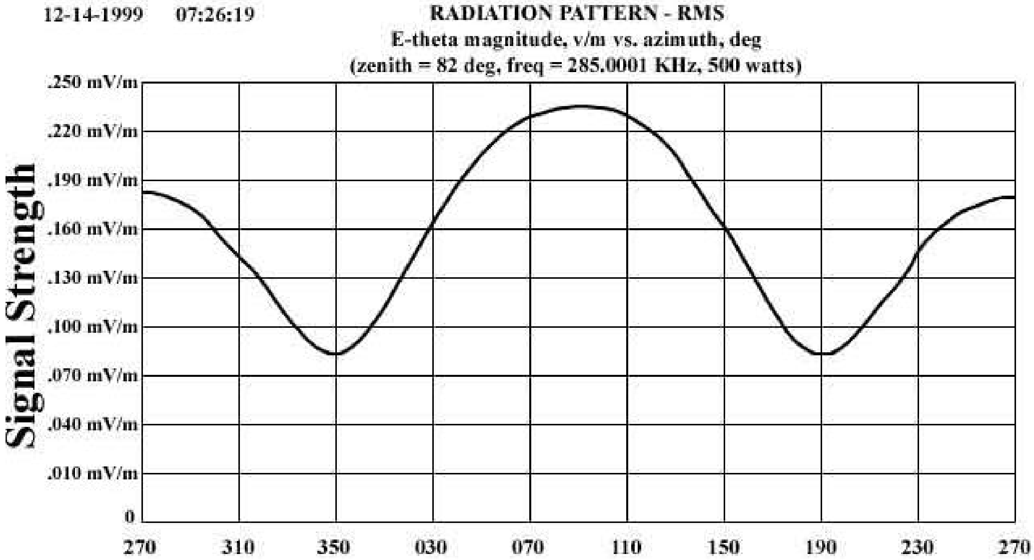


Fig #1: Radiation Pattern 500 km from Annapolis without TV tower.
Transmission Frequency: 285 kHz.



Note: Directions are not true bearings but based upon the TV antenna being 270 relative to the Annapolis antenna. True bearings are approximately 10 degrees less than displayed.

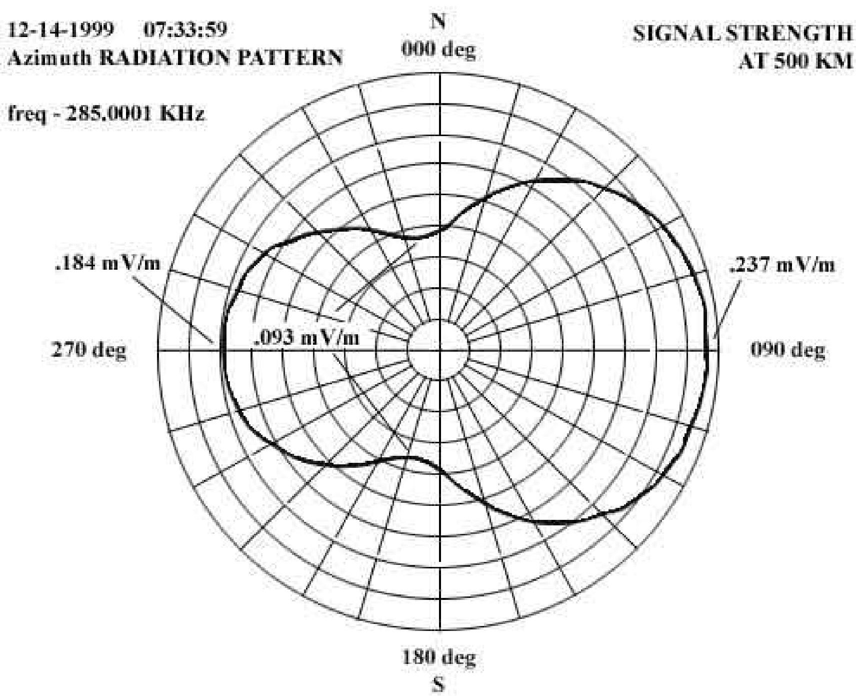
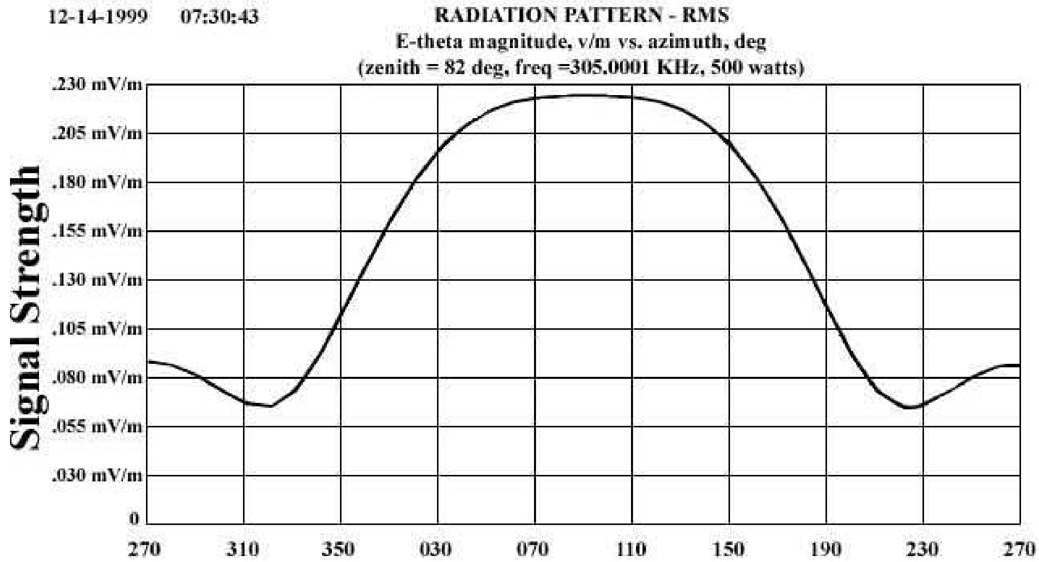


Fig #2: Radiation Pattern 500 km from Annapolis with the TV tower 270 degrees relative to GWEN tower. Transmission Frequency: 285 kHz.



Note: Directions are not true bearings but based upon the TV antenna being 270 relative to the Annapolis antenna. True bearings are approximately 10 degrees less than displayed.

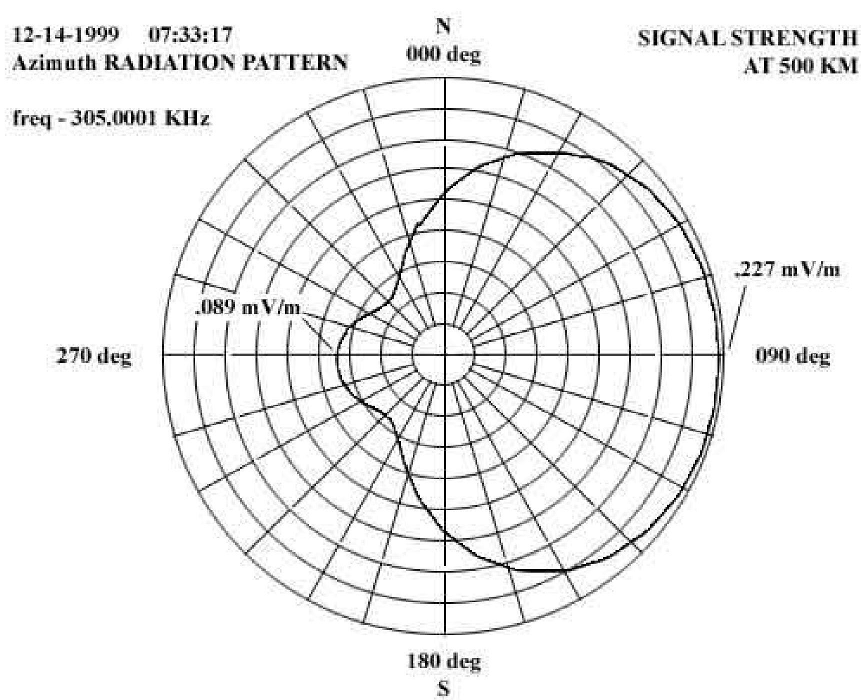
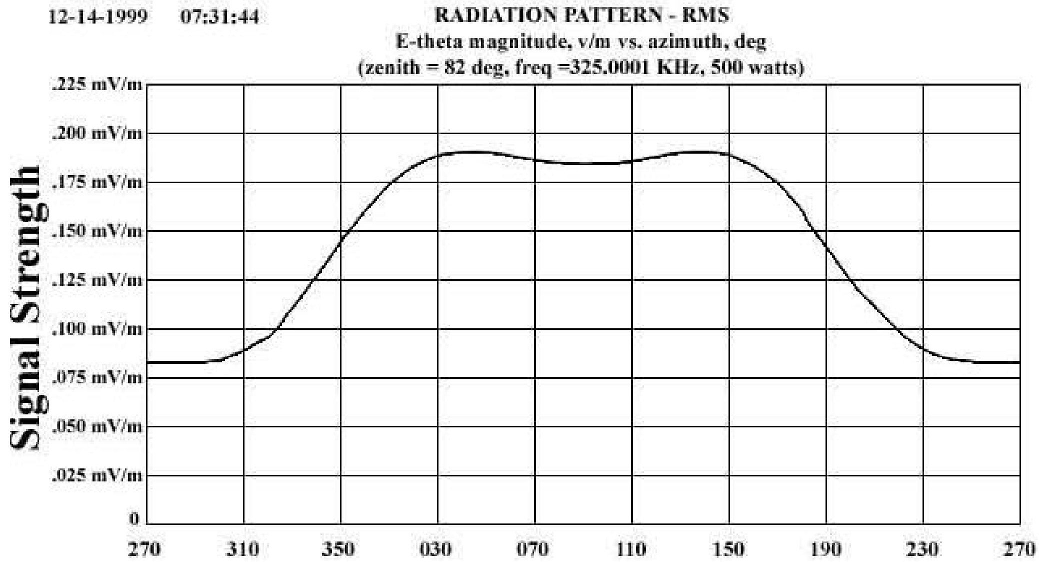


Fig #3: Radiation Pattern 500 km from Annapolis without TV tower 270 degrees relative to GWEN tower. Transmission Frequency: 305 kHz.



Note: Directions are not true bearings but based upon the TV antenna being 270 relative to the Annapolis antenna. True bearings are approximately 10 degrees less than displayed.

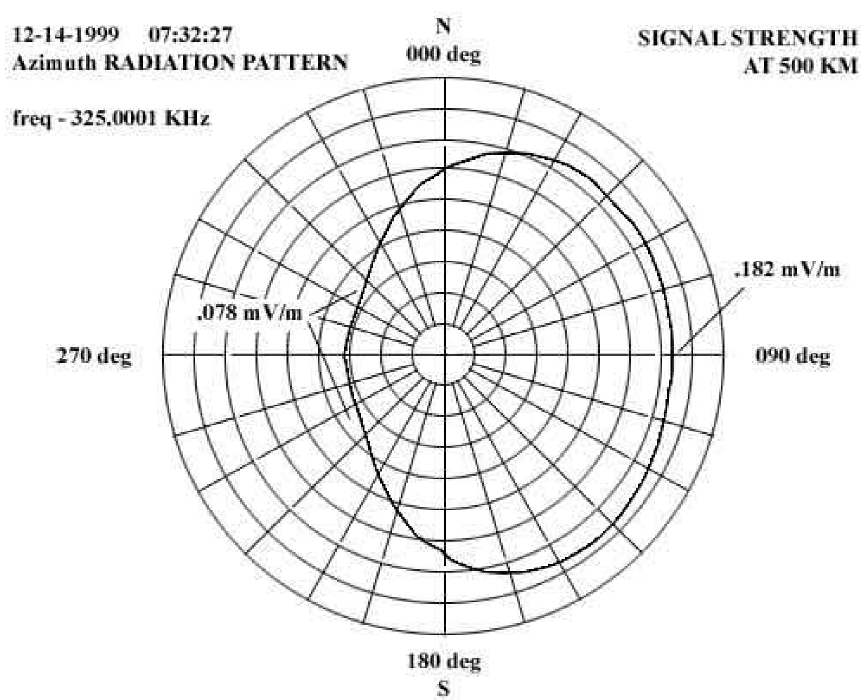


Fig #4: Radiation Pattern 500 km from Annapolis with the TV tower 270 degrees relative to GWEN tower. Transmission Frequency: 325 kHz.

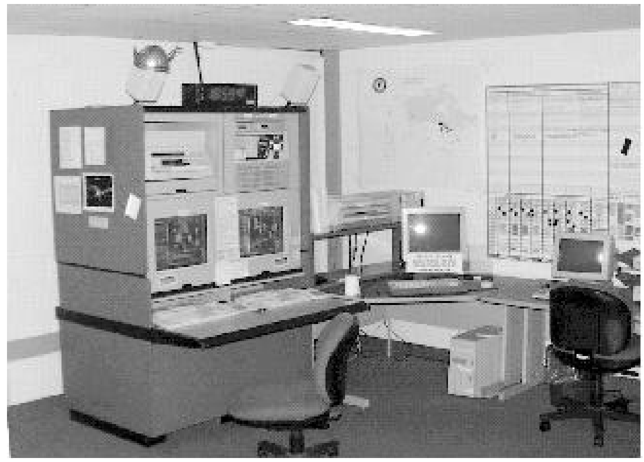
U.S.C.G. Navigation Center Detachment Consolidation

The USCG Navigation Center (NAVCEN) has recently submitted a proposal to consolidate the two NAVCEN detachments (Kodiak and Petaluma) into one larger detachment in Petaluma. Doing so will reduce general administrative overhead, streamline command functions, correct imbalances in the Loran-C watchstander distribution, improve the Loran-C data communications network in Alaska and provide significant annual savings due to elimination or downgrading of several billets. This consolidation is anticipated to occur in June of 2001. While significant challenges exist in order to meet this deadline, NAVCEN's Commanding Officer, CAPT Thomas Rice, remains optimistic that it will be accomplished as scheduled.

NAVCEN has recently submitted a proposal to consolidate (Kodiak and Petaluma) into one larger detachment in Petaluma.

The NAVCEN detachment in Kodiak contains the control station for the Northern Pacific Loran-C Chain, the Gulf of Alaska Loran-C Chain and the Russian/American Loran-C Chain. Currently, there are 12 billets in Kodiak: nine Watchstanders, a Watch Supervisor, a Control Station Supervisor and the Chain Operations Control Officer. The detachment is co-located with Electronic Support Unit Kodiak, a short distance from Integrated Support Command Kodiak (the Coast Guard's largest base). NAVCEN Detachment Petaluma is co-located on the Coast Guard's largest enlisted training facility, Training Center Petaluma. NAVCEN facilities in Petaluma include both Loran-C and Differential Global Positioning System (DGPS) control stations. The Loran-C Control Station monitors the U.S. West Coast Loran Chain and the North Central U.S. Loran Chain. The DGPS Control Station usually monitors those DGPS sites in the western half of the country, though they have the capability to take control of the entire DGPS system, should the need arise. Currently, there are 23 NAVCEN billets in Petaluma.

The Consolidation Proposal calls for building renovations at the NAVCEN Detachment in Petaluma in order to make room for the additional billets and the Alaska Loran-C control station. Currently, the Loran-C and DGPS control rooms share a single large room.



LORAN Control Station Console

Once renovations are complete, there will be two distinct control rooms, one for Loran-C and one for DGPS. Each will control all the DGPS or Loran-C sites in the western half of the United States. Other building renovations include converting storage rooms to office space and removal of asbestos from the modified spaces.

This consolidation will be absolutely transparent to all Loran-C and DGPS users**.**

If you would like more information concerning the plan please contact: LT John Thompson at (707) 765-7587 or CWO3 Bob Finstad at (707) 765-7595.

— LT John Thompson, NAVCEN, PETALUMA

.

CGSIC 37th

Meeting Announced

Mar. 27—29, 2001

Arlington, VA

GPS and the World Radio Conference-2000

Frequency Protection

Frequency is one of the most valuable of commodities in today's world of cellular phones, satellite Internet services and live satellite broadcasts of our favorite football games. It seems that every day someone is inventing a new application which needs a precious sliver of frequency to operate . Once a frequency has been assigned, it is necessary to vigorously protect it from interference caused by applications operating on adjacent frequencies. To get or protect frequencies, one has to go before the members of the International Telecommunication Union at the World Radio Conference (WRC) held every three years.

GPS Outreach

At WRC-1997, an INMARSAT proposal requested Mobile Satellite Services (MSS) be allowed to co-share the lower 8 MHz of the frequency spectrum allocated for use by maritime and aeronautical radio aids-to-navigation. "Co-share" meant they wanted to operate on a presently unused portion of the band until it was needed or it was determined they were becoming a problem. The radio-navigation band spans from 1559-1610 MHz. The very weak (50Hz) Global Positioning System (GPS) satellite signal occupies a band in the middle of that spectrum at 1575.42 MHz. Studies during the following three years confirmed the risk of interference to GPS and it was clear to the U.S. Government an outreach effort was necessary to protect U.S. worldwide GPS interests. An Outreach Committee was formed and an exhibit booth committee became an offshoot of it under the auspices of a joint-State and Commerce Department initiative. The Coast Guard's Navigation Center became a part of this committee. The nomination was logical based upon Navcen's position as the government-designated liaison to the world for civil use of GPS. Navcen also provided maritime expertise for the assembled team of people chosen to staff the booth.

The mission, simply put, was to staff the exhibit at various strategic venues around the world, educating senior economic and telecommunications officials on the worldwide benefits of GPS and, particularly, how GPS is being used in their own countries to the benefit of all who live there. The goal was to convince these officials of the necessity to protect GPS spectrum from the interference risk posed by WRC-2000 Resolution 220.

U.S. GPS outreach booth at the APEC-20 conference in Lima, Peru

History of Booth Deployment

- White House Old Executive Building, Washington, D.C. - October 98
- WRC Plenary meeting, Minneapolis, MN - November 98
- Pacific Telecommunications Council (PTC) Conference, Honolulu, HI - January 99
- Asian Pacific Economic Council (APEC) Conference, Miyazaki, Japan - March 99
- Paris Air Show, Le Bourget, France - June 99
- UNISPACE III Conference, Vienna, Austria - July 99
- APEC Conference, Lima, Peru - September 99
- WRC Conference Planning Meeting (CPM) Geneva, Switzerland - November 99
- WRC-2000 - May 2000
- GPS Industry Day, Rayburn Senate Building, Washington D.C. - June 2000
- House Appropriations Committee hearings on WAAS, Washington D.C. – June 2000

Countries Briefed

At the WRC alone, records indicate delegations from 82 different countries were briefed, a number that belies the actual hundreds of briefings conducted there. Over the year and a half spent working with the booth, hundreds of delegations were briefed representing approximately 102 separate nations from all over the world. That number is in addition to the thousands of people who just stopped by to see what the booth represented. During the Paris Air Show, there were between 150,000 and 200,000 people who passed by the booth, thousands of which stopped for a short education in GPS. While in Peru, the team had the good fortune to be able to teach an entire Catholic school the basics of GPS. To fill time between conference breaks the school Principal was contacted suggesting that perhaps their science class might be interested. Much to everyone’s surprise, over the next few days the school paraded over seven hundred students, 20-30 at a time, through the briefing. Word of this reached their parents, who, as it turned out happened to be some of the most influential people in Peru, and they began to drop by to see what their children had been so excitedly talking about.

Conference coordinator Mona Alberti acting as interpreter for a group of students from the Catholic Girls School in Lima, Peru

Author shares briefing of DOT Appropriations delegation

WRC-2000

Work with the Outreach Booth Committee culminated with the display at the World Radio Conference in Istanbul, Turkey, from 04 May through 04 June 2000. The U.S. government’s stand on GPS and other spectrum protection issues had been honed to a fine point by this time. The team received final briefings at a State Department meeting prior to leaving for Turkey. Attempts to achieve U.S. goals challenged the team’s diplomatic skills every single day. Significantly, the team even convinced many hostile European GALILEO proponents that GPS spectrum protection was in their best interest as well, perhaps setting a precedent for protection of their own frequencies at a later date. Many officials from around the world returned to the booth throughout the conference for updates on the status of the spectrum protection issues.

A Triumph Heard Round The World

The following is an excerpt from an Interagency GPS Executive Board (IGEB) bulletin synopsizing the results of voting on various GPS issues:

- MSS Sharing: The U.S. was ultimately victorious in suppressing Resolution 220 from the WRC-2000 from the WRC-2000 agenda. Other WRC relating to MSS spectrum specifically excluded the possibility of considering the GPS/Glonass band at 1559-1610 MHz.

- L5: A 51-MHz RNSS allocation was made to accommodate both L5 and E5 at 1164-1215 MHz. That is, 24 MHz for L5 (1176+/-12 MHz) and an additional 27 MHz for Galileo E5. An aggregate power flux density (pfd) limit has been imposed on the entire band, which could create problems for existing aeronautical systems such as DME's. Additional studies were directed on the pfd issue.

- Space-to Space: The U.S. succeeded in gaining space-to-space RNSS allocations at L1 and L2. However, a footnote stipulates that these allocations are "not intended to provide safety service application, and shall not impose any additional constraints on other systems or services operating in accordance with the Table of Frequency allocations." A new space-to-space allocation was also granted at L5— something we did not expect to gain until the next WRC— and with no footnote.

- Regional Footnotes: Footnotes allowing certain GPS/Glonass bands were deleted.

- L2: A new study was directed on imposing a power flux density limit in the L2 band during the next WRC. The U.S. strongly opposes pfd limits affecting current operational systems.

- Galileo: Galileo also succeeded in gaining several new allocations— L5/E5 (space-to-earth & space-to-space), 1260-1300 MHz (space-to-earth & space-to-space), 5010-5130 MHz (space-to-earth & space-to-space), 1300-1350 MHz (earth-to-space), and 5000-5010 MHz (earth-to-earth).

- Outreach Booth: Many on the U.S. delegation have credited the GPS booth team for contributing significantly to our success at the conference. Over the course of the entire month, the booth was visited by delegates from 82 different countries as well as congressional staffers (DOT appropriators) and TV reporters.

For now, WRC-2000 has ensured the continued operation of GPS and other radio aids-to-navigation safety-of-life applications for all the people of the world. As frequency management becomes more and more necessary, so will the issues decided by the hard working members of the ITU become more and more critical.

WRC-2000 conference breaks brought groups from all over the world to GPS briefings

Author's personal comment: I was very fortunate to have been given the opportunity to participate in the GPS outreach effort and for the chance to make the Coast Guard an instrumental part of it. I spoke with and briefed literally, thousands of wonderful people from all over the world. Those people were everything from dignitaries, to scientists, to blue-collar workers, and I am a better person for having met and experienced the wonderfully rich diversity of the entire planet. And to top that, to be credited with even a small part in the success of such major international issues has given me a feeling of great personal accomplishment. I feel I have been part of something very significant.

— QMCM Rick Hamilton, NAVCEN

Author briefing reporter from the University of Hawaii at the Pacific Telecommunication Conference in Honolulu, Hawaii

Operational Status of Loran Equipment Modernizations

Abstract:

In January 1997, the Federal Aviation Administration (FAA) and the Coast Guard developed an Interagency Agreement for the upgrading, and modernizing the existing Loran-C System. The Coast Guard Loran Support Unit has undertaken a number of projects, which strive towards this goal. This paper reports on those efforts, which have, or are coming to, fruition within the immediate future. Some are currently passing the transition from engineering to operations. The following five Loran improvement projects will be covered:

The Automatic Blink System (ABS) monitors the timing at the local transmitting station and starts proper blink secondary whenever ABS detects a 500nS or more disagreement between local timing sources. In the event of a Master timing abnormality, the master station is taken off air. This system was brought on line in June 2000.

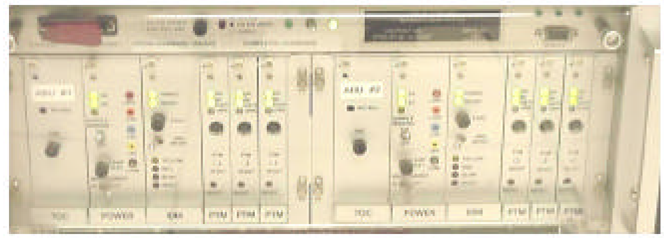
Uninterruptable Power Supplies (UPS) have been fielded for testing at LORSTA Jupiter. These units back up the entire Loran suite of equipment at a solid state transmitter (SSX) station. The Operations room UPS has been selected for installation at SSX stations. The Transmitter room UPS, which backs up the SSX, was used as a proof of concept.

The Remote Automated Integrated Loran (RAIL) System is designed to integrate the various Loran station equipments and automate numerous functions. RAIL is designed to be the local transmitting station's command and control system and the remote interface for the Loran Consolidated Control System (LCCS).

The PDP-8 and Austron 5000 Primary Chain Monitor Set (PCMS) have been replaced with the Locus LRS-III receiver at all 29 United States and Canadian monitor sites. The Locus receivers are less labor intensive and provide a higher degree of reliability.

The Prototype Automated Loran Station (PALS) project is testing whether a modified Loran station will allow the Coast Guard to remove staffing from a Loran station while maintaining the high degree of availability historically enjoyed by the Loran-C system. Loran Station Jupiter is currently testing this concept through a PALS test, which began on 02 April 2000.

The Automatic Blink System



The Automatic Blink System, or ABS, was installed at all U.S Coast Guard Loran stations and brought on line on 30 June 2000. The Federal Aviation Administration (FAA) non-precision approach requirement, calling for ten second notification of Loran-C signal abnormalities, could not be met with standard operating procedures that were dependant upon human intervention at Loran transmitting stations. The initial ABS project, which began in 1991 under the auspices of the FAA, was cancelled in 1994 due to a lack of funding. In 1997, the ABS program was resurrected through upgrade and modernization efforts contained in an Interagency Agreement between the FAA and USCG.

The main purpose of the ABS is to detect timing anomalies and notify the user. It was also designed to notify transmitting station and control station watchstanders of said timing anomalies through a series of audio and visual alarms and messages. ABS also assists in filling requirements identified for un-staffed Loran Station (LORSTA) operations. From an operational perspective, two immediate benefits of the ABS are:

- **increased reliability through proper user notification of timing anomalies in less than ten seconds, and**
- **reduced risk for potential out of tolerance without proper blink caused by incorrect human intervention, equipment failures, and communications outages.**

The ABS is comprised of two redundant Automatic Blink Units (ABU) and an Automatic Blink Controller (ABC). The ABU comprises the heart of the blink functionality, monitoring appropriate inputs from the local timing receiver, three cesium oscillators, Timer Set Control (TCS), and the RF feedback loop, to determine if a need for blink exists and to start blink if necessary. The ABC serves as the interface between both ABU's and other Loran-C equipment. It is used to switch the on line functionality between the redundant ABUs. Front panel ABC controls allow for manually selecting the on line ABU and for placing the ABS in either a hardware bypass mode. The hardware bypass mode, which removes the ability of the ABS to automatically start blink, may be employed for local transmitting station maintenance of those equipments which supply inputs to the ABS. Transmitting station personnel must contact the appropriate Coordinator of Chain Operations (COCO) prior to placing the ABS into a bypass mode.

The ABS is capable of detecting timing anomalies greater than 50 nanoseconds (nS). However, due to the inherit jitter of the local transmitted signal, unnecessary blink was observed to occur whenever the tolerance was set below 300 nS. Therefore, the 500 nS tolerance, plus or minus 20 nS, which coincides with FAA specifications, was selected.

For secondary LORSTA timing anomalies, the ABS begins secondary blink within two seconds of a local timing anomaly. This ABS-induced blink state will continue for a minimum of thirty seconds and will continue until blink is secured by human intervention. The ABS unit will not allow blink to stop until the signal is back within the 500 nS window.

For master LORSTA timing anomalies, the ABS inhibits the timer's multi-pulse triggers, thereby taking the master off air. Without the master station, users throughout the given coverage area will not be able to determine their position hyperbolically.

The ABS also monitors the signal received from the other transmitting station that makes up a given baseline. This signal is used to substitute for the cesium inputs when two of those signals are missing. This allows operators to perform some of the necessary maintenance at the transmitting station without effecting the ABS units capabilities.

During normal operations, the ABS will synchronize itself hourly by resetting all offsets to zero. In this manner, some events such as small incremental cesium drift, local phase adjustment corrections, and small propagation time variations will be accounted for. The ABS can also be synchronized manually via the front panel or by remote control should the need exist.

An unforeseen benefit of the ABS has been identifying slight equipment problems that could lead to longer intervals of unusability or equipment down time. Intermittent faulty Multi-Pulse Triggers activity at one of our LORSTA's resulted in ABS blink being generated. These spikes were of such short time duration that local and remote-monitoring equipment did not detect an equipment problem. The faulty timer was repaired and brought back on line.

To date, the installed ABS throughout the Coast Guard LORSTAs have successfully initiated blink when timing anomalies greater then 500 nS have occurred. The Coast Guard has formally notified the FAA that ABS installations are complete.

Operations (OPS) Room Uninterruptible Power Supply

Until recently, loss of power to the Timer Room or Transmitter Room has resulted in Loran-C unavailability for the affected baseline. During the past year, the Loran Support Unit (LSU), after evaluating and testing a number of uninterruptible power supplies, installed a Symmetra uninterruptible power "array", or supply (UPS), at LORSTA Jupiter.

The Symmetra Power Array Master Frame system, such as the one installed at LORSTA Jupiter, is capable of providing a maximum of 16kVA. The array provides conditioned AC power and protects the installed Loran equipment in the Operations Room from input power variations resulting from surges, blackouts, and brownouts. The main components of the Symmetra array are the power processing system, a battery bank, and the control/user interface. All components of the Symmetra Array are housed within one master frame.

During normal operations, the power processing system receives either commercial or station generator set (GENSET) AC power, conditions the received power through a bank of power modules operating in parallel, and routes the conditioned AC power to the OPS Room equipment. An additional power module is installed within the master frame to provide redundancy in the event one of the power module fails. In the absence of commercial or installed GENSET AC power, the power received from the battery modules within the master frame is converted into conditioned AC power and routed to the OPS Room equipment. Hot swappable, parallel 120V battery modules supply Battery power. Each battery module consists of ten 12V batteries.

The control/user interface is responsible for coordinating power up and power down states, enabling transfer between bypass states, and switching between incoming commercial or GENSET power and battery modular power. Additionally, the control/user interface runs diagnostic tests and reports the Symmetra power array status, providing both audio and visual alarms for degraded operations.

The bypass mode allows the technician to electrically remove the Symmetra from the OPS Room equipment power flow in the event maintenance of the Symmetra is warranted. During normal operation, the control/user interface reports the present load, the predicted amount of time the load could be sustained by the battery source, current individual battery module and power modules status, and displays the input and output voltage and frequency.

The control/user interface alerts the operator to a variety of alarm conditions through audio and visual alarms and messages. Alarm conditions include loss of input power, degradation of input power, battery source enabled, loss of bypass ability, power and battery module failures, and load increases.

The Symmetra has been on line at LORSTA Jupiter for the past six months without any failures and has provided seamless transition between commercial/GENSET power and battery source power. According to the manufacturer's specifications, the Ops Room load was calculated to last 61 minutes. LORSTA Jupiter successfully ran the OPS Room on the UPS for 50 minutes without any power interruptions.

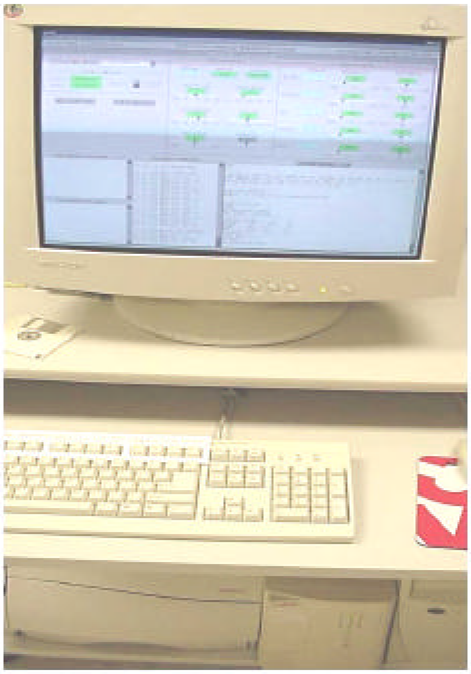
Current LSU modernization efforts call for the installation of the Symmetra Power Array at more solid state transmitter (SSX) LORSTAs during the current fiscal year. Operationally, it is anticipated that availability will not be affected due to commercial/GENSET power loss, operators will be able to ascertain UPS and incoming power problems rapidly, and a reduction in time troubleshooting the variety of UPS systems currently in place will result.

The Transmitter Uninterruptible Power Supply

A Powerware System 80, manufactured ten years ago, was installed at LORSTA Jupiter for a proof of concept test. This system, though ten years old, provided battery back up for the SSX whenever there was an interruption of commercial or GENSET power. LORSTA Jupiter ran the transmitter on the UPS for 25 minutes: the control panel indicated another 10 minutes of power was available. LSU is currently researching a newer type of transmitter UPS for the SSX.

The Remote Automated Integrated Loran (RAIL) System

Another modernization project which has been fielded during the past year is the Remote Automated Integrated Loran system, commonly referred to as RAIL. The RAIL system is composed of Loran specific software developed by LSU and incorporated into a Windows NT system. The RAIL system centralizes numerous command and control functions previously performed by a variety of LORSTA equipment. Overall, the RAIL system is being prototyped in three distinct phases, although some functionality is incorporated through two successive phases.



RAIL Phase I replaces the Coast Guard Standard Workstation II (CGSWII) for communications between the control and transmitting stations. RAIL interfaces operational commands, such as blink commands, and operational traffic between the equipment and operators at either end. Both course and fine control parameters are electronically digitized and recorded for current and future reference. Additionally, RAIL Phase I interfaces with the installed ABS and, where applicable, the Time of Transmission Monitors (TTM).

The home screen displays seven fields and reports the current status of all equipment interfaced with RAIL. The LORSTA's operating mode (for example, station maintenance) and rate information for dual rated stations is displayed. The Delta field displays the current course and fine values for signal characteristics. Additionally, a cycle comp value ranging in value from -100 nS to +100 nS and a receiver amplitude value are also displayed. Double clicking on the appropriate icon allows the operator to adjust the tolerance threshold.

A value is displayed for each parameter, indicating the value's offset from center scale. The background of the value field will change between green, yellow, and red, indicating if the value is in tolerance, approaching tolerance, or out of tolerance. Similar fields for Bravo data at a master station are also displayed.

The high priority and low priority alarms fields provide messages when a LORSTA is approaching an out of tolerance condition, is out of tolerance, or is operating at reduced capabilities. The alarm commands field provides a running log of all high and low priority alarms as well as commands entered through RAIL.

The terminal window field can be used to interface with equipment connected to RAIL. Additionally, the Delta local screen can be accessed through the terminal window. This screen displays course TINO value and tolerances, digitized charts for fine TINO (also known as Master-local phase) and received signal amplitude, LOCUS receiver messages and parameters, and an alarms/commands field. Similar screens can be brought up for a Master station.

RAIL Phase II provides a local and remote interface with the Locus receiver. Back up communications with the Loran equipment is provided through Phase II. All data collection functionality currently performed by the installed Local Site Operating Set (LSOS) equipment will be accomplished by RAIL. This provides the control station watchstander ease of access to LSOS for control functions, such as switching timers, as LSOS will no longer be engaged in compiling data rounds. Upon further Loran Consolidated Control System (LCCS) software upgrades, LCCS and RAIL will be integrated to optimize communications and operations between the transmitting and control stations, as well as allow for remote control of the LORSTAs installed Locus receiver.

Finally, in Phase III, RAIL is anticipated to replace all LSOS functionality. Phase III may automate the Loran Operations Information System (LOIS) data gathering functionality, used to analyze a variety of signal trends, via the Loran Consolidated Control System (LCCS) at the control station and RAIL. Phase III will allow the control station watchstanders to perform a variety of tasks, many of which are currently available through LSOS. One common example is the remote switching to a variety of standby Loran equipment in the event the on line equipment fails.

Currently, RAIL systems are installed at LORSTAs Jupiter, Seneca, and George. Both NAVCEN and LSU have the ability to connect to LORSTA Jupiter's RAIL to check operations and run diagnostics. All data is archived and copied to a tape.

The Locus LRS-III Receiver

The Locus LRS-III receiver has replaced the CDFO-5000/PDP8 equipment at all 29 Primary Chain Monitor Set (PCMS) sites throughout the United States and Canada. All United States PCMS sites were swapped out during a two month period through the efforts of LSU, NAVCEN, NAVCENDET Petaluma, and NAVCENDET Kodiak personnel. The last Canadian PCMS site was swapped out 02 November 2000.

One of the main differences between the LRS-III and its predecessor is the number of chains which can be acquired and locked onto. The previous generation of equipment could only lock onto two chains simultaneously. The LOCUS receiver is capable of locking onto 9 chains. The control stations set up the receiver with the 8 closest chains capable of causing cross-rate interference leaving the 9th chain for the Calibration Chain.

Recent software changes have increased the receiver's capability to track 11 chains. This modification has been installed at LSU, the Cold Bay, AK and Point Cabrillo, CA monitor sites and the Navigation Center Detachment in Petaluma. To date NAVCEN Detachment Petaluma has been able to lock onto 58 baselines in 16 chains, spanning the area from the Chinese Chain (6930) to the Canadian East Coast chain (5930).

A considerable amount of effort was expended to incorporate the predecessor's commands, report, and fault generation messages formatting into LRS-III operations. This enabled an almost seamless transition between CDFO-5000 and LRS-III control and operations and prevented the expenditure of numerous hours learning a new system at the three Loran control stations at Alexandria, Virginia, Petaluma, California, and Kodiak, Alaska.

The use of the LRS-III allows for a "plug and play" replacement for the servicing technician: in the event of failure, the entire unit is replaced and returned to the manufacturer for repair. This ability has significantly reduced lengthy troubleshooting efforts repairing an antiquated system, travel throughout the United States and Canada to troubleshoot the CDFO5000/PDP8 suite, and significantly reduced the amount of time a chain is operated in a degraded mode of control.

Prototype Automated Loran Station (PALS)

Loran Recapitalization Project (LRP) efforts have resulted in the design, construction, installation, and operation of automated Loran equipment. These technological advances automate and simplify the day-to-day on scene requirements of LORSTA personnel. On 02 April 2000, a field test commenced at LORSTA Jupiter, FL of a Prototype Automated Loran Station (PALS). Under the PALS test, the techniques, policies, procedures, equipment, and infrastructure changes required to reduce the operating costs of a Loran station were examined. LORSTA Jupiter was selected as the test site for the following reasons:

- LORSTA Jupiter has a 32 Half Cycle Generator (HCG) solid-state transmitter (SSX). In comparison to the tube-type transmitter (TTX) used elsewhere in the Loran system, the SSX is less maintenance intensive, most of the transmitter can be repaired while the station is on air, and corrective maintenance evolutions are simpler and less time consuming than at TTX stations.

- LORSTA Jupiter is a single rated secondary station: along with the master station it comprises one baseline of one chain. The geographic area affected by outages is considerably larger for master or dual-rated secondary station casualties.

- Power lightning hits have been the cause of inordinate amounts of unusable time within the Loran community. Numerous equipments can be tripped off line and, in some cases, damaged beyond organizational and intermediate level repair.. Large seasonal thunderstorms also precipitate commercial power fluctuations, which further increase the amount of unusability. Historically, LORSTA Jupiter is the worse case condition for lightning strikes and commercial power fluctuations caused by inclement weather due to its location.

Under the PALS concept, operational costs are primarily reduced by:

- Addressing Loran operational and electronic maintenance concerns through an existing, nearby USCG Electronics Support Detachment (ESD) rather than having electronic technicians attached to the LORSTA, and

- Addressing Loran facility maintenance, including the installed generator set (GENSET), through a matrix of contracts and USCG engineering personnel assigned nearby.

Based upon the results of the initial PALS test period, no increases in unusable time or reduction of operational readiness outside the norm were observed. The test results showed the automation of a LORSTA is technologically feasible.The time frame of the PALS

Jupiter test has been too short to accurately measure possible mean time between failures (MTBF) caused by a reduction of preventive maintenance procedures. Thus far, no detrimental effects have been noted during the six-month PALS test period at Jupiter. LSU has also analyzed the Canadian Preventive Maintenance Schedule (PMS) program, which calls for less frequent PMS than PALS CGPMS. No detrimental effects have been noted at the Canadian Loran systems due to a reduction of preventive maintenance.

A PALS working group, consisting of various Coast Guard units, has been convened to study the feasibility of further automations in the Loran system.

DISCLAIMER

The views expressed herein are those of the author and are not to be construed as official or reflecting the views of the Commandant or the U.S. Coast Guard.

BIOGRAPHY

Captain Thomas Rice. assumed his current position as Commanding Officer of the Coast Guard Navigation Center in Alexandria, Virginia, in July 1999. He graduated from the United States Coast Guard Academy in 1977 with a Bachelors of Science degree in Management. In 1990, Captain Rice graduated from the Naval Postgraduate School in Monterey, CA where he earned a Masters degree in Telecommunications Systems Management. Throughout his multifaceted career, Captain Rice has served at Coast Guard Headquarters, Support Centers Alameda and Kodiak, and as Deputy Commander of Surface Effect Ship Division in Key West, FL. He has also served aboard USCGC BIBB (WMEC-31), USCGC GALLATIN (WHEC-721), USCGC DILIGENCE (PRECOM), and as Executive Officer aboard USCGC CHILULA (WMEC-153), and Commanding Officer aboard USCGC MOHAWK (WMEC-913).

As Commanding Officer of United States Coast Guard Navigation Center, Captain Rice serves as the operational commander of all United States Loran-C stations, Differential Global Positioning System (DGPS) broadcast facilities, oversees the nationwide expansion of DGPS. He is also responsible for the dissemination to the general public of the status, availability, and technical standards for all assigned Electronic Navigation systems.

Lieutenant David W. Fowler assumed his current position as Loran Management Branch Chief in May, 2000. He has served aboard Loran stations Fallon, Marcus Island, Malone, Iwo Jima, LORMONSTA Kaneohe, and as Commanding Officer of LORSTA Attu. He reported aboard the Navigation Center in August, 1999 and served as the DGPS Management Branch Chief from August, 1999 through May, 2000. Lieutenant Fowler holds an Applied Associates Degree in Electronics Engineering Technologies from the Albuquerque Technical Vocational Institute.

The authors appreciate the assistance of CWO Kirk Montgomery in the preparation of this paper.

—— CAPT Tom Rice & LT Dave Fowler, NAVCEN

Contacting the Navigation Information Service (NIS)

Internet:

http://www.navcen.uscg.mil
ftp://ftp.navcen.uscg.mil

E-Mail:

nisws@smtp.navcen.uscg.mil

GPS Status Recording:

Telephone: (703) 313-5907

WWV/WWVH Radio Broadcast:

WWV broadcasts by telephone or radio at 14-15 minutes past the hour and WWVH at 43-44 minutes past the hour. Radio frequencies: 2.5, 5, 10, 15, & 20 MHz.
Telephone: (303) 499-7111

Write or Call:

Commanding Officer (NIS)
U.S. Coast Guard Navigation Center
7323 Telegraph Road
Alexandria, VA 22315-3998
Telephone: (703) 313-5900
Fax: (703) 313-5920

Coast Guard SDL No. 137

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1	1	1		1	1	1	1	1	1		1	1	1	1	1	1		1		2					
B		10	10	3	10	2	2	5	5	2	5	3	3	3	3	2	1	5	3	1	1		2	2	5	1
C	5	3	1	5	2	3	3		1	1	3	2	1	5	1		1	1	1	1	1	2	2	1	1	1
D	1	1	1	2	1	1		1	1	1	1	1	1		1	1			1	2	1	1	1			1
E	1		1				1	1		1	1	1	1	1	1				1	1		1	1			
F																	1	1	1							
G	1	1	1	1	1																					
H																										

NON-STANDARD DISTRIBUTION: CG-31 (1), CG-56 (1), CG-64 (1)